U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Fisheries Center
2725 Montlake Boulevard East
Seattle, Washington 98112

December 9, 1976

CRUISE RESULTS

EASTERN BERING SEA SYNOPTIC TRAWL SURVEY

March - June 1976

Cruise C-76-1

CRUISE PERIOD

R/V Miller Freeman--March 15 - June 4

R/V Oregon--May 24 - August 13 (The Oregon's participation in the synoptic trawl survey extended only through late June.)

Chartered M/V Anna Marie--April 5 - June 30

Chartered M/V Pat San Marie--April 8 - June 30

ITINERARY

The Miller Freeman departed Seattle March 15 and returned to Kodiak on June 4 to complete the demersal trawling phase of her cruise. Intervening port calls were made at Kodiak on March 27-28 to pick up scientific personnel, at Adak on April 21-24, and at Seward on June 3 for exchange of scientific personnel and for fuel and other supplies.

The Oregon departed Kodiak May 24 and returned August 13 to complete the demersal trawling phase of her cruise. The Oregon's participation in the synoptic survey was integrated with the annual crab-groundfish survey; the latter survey extended to mid-August. Intervening port calls were made at Dutch Harbor on June 2-5 for repairs and June 14-19, July 14-19, and August 13 for exchange of scientific personnel and for fuel and other supplies.

The chartered vessels Anna Marie and Pat San Marie departed Seattle April 5 and April 8, respectively. Scientific personnel boarded the charter vessels at Dutch Harbor on April 19. Other port calls were made at Dutch Harbor on May 6-10 and May 31-June 3 for exchange of scientific personnel and resupply of fuel and water. Scientific personnel departed the charter vessels at Naknek on June 21 (Anna Marie) and at Dutch Harbor on June 21 (Pat San Marie). The vessels reached Seattle on June 30 to complete their cruises.

SURVEY AREA

The area surveyed extended from about 60°N and 176°W and south along the continental slope to Unimak Pass and eastward to the Alaska mainland (figure 1).

OBJECTIVES

The four-vessel survey provided baseline information on demersal resources of the eastern Bering Sea to satisfy the dual objectives of providing information for (1) the Outer Continental Shelf Environmental Assessment Program (OCSEAP) and (2) the Northwest and Alaska Fisheries Center's (NWAFC) continuing assessment of the condition of finfish and shellfish resources of the region. Funding for this survey was partially provided by OCSEAP. Information provided to OCSEAP will be used by the Bureau of Land Management (BLM) to prepare an impact statement concerning possible offshore exploration and development of oil reserves in the area.

Specific objectives of the survey were to:

1. Describe the species composition and distribution and abundance of individual species of demersal fish and invertebrates of the eastern Bering Sea in spring by region and depth. Results of the spring survey, which is expected to describe the winter-spring distribution of resources, will be contrasted with that in summer from a similar multi-vessel survey in August-October 1975.

2. Estimate, for selected demersal fish and invertebrate populations, the standing stock, size and age composition, growth rates, and length-weight relationships.

3. Measure selected oceanographic parameters which may affect the environment and distribution of these populations.

4. Provide baseline information which can be compared with historical information available from the literature, existing data sources, and with future survey information.

5. The Miller Freeman, in addition to meeting the above objectives, served as a platform for investigations on:
   (a) benthic invertebrates;
   (b) fish diseases;
   (c) marine birds;
   (d) food habits of demersal fish;
   (e) ichthyoplankton; and
   (f) physiological adaptations of fish to cold water.

GEAR

Modified eastern fish trawls were used on each vessel. Trawls on the Miller Freeman, Anna Marie, and Pat San Marie had 112' footropes, 83' headropes, and 4" mesh in the wings and body and 3½" mesh in the intermediate and codend. The Oregon trawl had a 94' footrope and 71' headrope

and the same mesh sizes as the larger trawls used by the other vessels. All of the trawls had codend liners with 1¼" mesh for the retention of small fish and invertebrates. Doors were 6' by 9' on the Oregon and Anna Marie, 7' by 9' on the Pat San Marie and 7' by 10' on the Miller Freeman.

Water column temperatures were measured by XBT profiles from the Anna Marie, Miller Freeman, and Oregon. Salinity and temperature at depth were measured by a CTD instrument from the Miller Freeman. Calibrated bucket thermometers were used by the Miller Freeman and Anna Marie to obtain surface temperature data.

METHODS

The survey was designed to synoptically cover the major part of the distribution of commercially important species of demersal fish and shellfish in the eastern Bering Sea. Due to the timing of the survey, starting in early April, ice cover was expected to limit the areal coverage relative to that of the summer 1975 multi-vessel survey. The planned areal coverage was therefore more limited than in summer 1975. Greater effort, however, was directed to coverage of the slope area and to inshore waters less than 40 m in the spring survey than in the summer survey. Depths fished ranged from less than 40 m to about 500 m. The same stratified-systematic station pattern used in the summer 1975 survey was followed. The station densities varied depending on the known distribution of main concentrations of principal species of fish and shellfish, the probable location of oil lease sites, and areas with high potential for environmental impact (Figure 1). Station densities were highest (about one per 125 square miles) or waters less than 40 m along the north side of the Alaska Peninsula and in Bristol Bay and lowest in the northeast region of the area surveyed (one per 400 square miles in subarea 4). In other subareas where relatively high concentrations of pollock, flounders, and crab were expected, station densities were one per 250 square miles. One-half hour tows were made at each station.

Methods of processing the catches for fish and invertebrates, other than commercial species of crabs, were as follows. Catches of less than about 2,500 pounds were entirely processed--that is, sorted by species, then weights and numbers determined for each species. For larger catches, a sub-sample of about 25 to 50% of the total catch was processed. After the catch was sorted, samples of fish were randomly-selected for length frequency and length-maturity determinations. Length-weight and age structure samples stratified by size were also taken for the principal species. These species included:

Pollock (Theragra chalcogramma)
Yellowfin sole (Limanda aspera)
Rock sole (Lepidopsetta bilineata)
Flathead sole (Hippoglossoides ellasodon)
Pacific halibut (Hippoglossus stenolepis)
Pacific cod (Gadus macrocephalus)
Sablefish (Anoplopoma fimbria)
Pacific ocean perch (Sebastes alutus)
Arrowtooth flounder (Atheresthes stomias)

Alaska plaice (Pleuronectes quadrituberculatus)
Greenland turbot (Reinhardtius hippoglossoides)

Commercial species of crab were completely removed from almost all catches, including those of more than 2,000 pounds. These were sorted by species, then sex and weights and numbers recorded. All crabs were measured, except in the case of large catches when a sub-sample was taken to provide measurements on a minimum of approximately 300 crabs. In addition to carapace measurements, shell condition, clutch size and egg color were recorded for many of the specimens. Species examined were:

Red king crab (Paralithodes camtshatica)
Blue king crab (P. platypus)
Golden king crab (Lithodes aequispina)
Tanner crab (Chionoecetes bairdi and C. opilio)

Also receiving special study were several genera of snails including Neptunea, Buccinum, Volutopsius, Fusitriton, Beringius, and Plicifusus. Information on the distributions and abundances of other invertebrates such as sea anemone, other crabs, nudibranches, clams, starfish, sand dollars, sea urchins, starfish, sea cucumbers, sponges, and sea pens was also collected by each vessel. The most detailed information on these epibenthic invertebrates was collected on the Miller Freeman by personnel from the Institute of Marine Sciences, University of Alaska.

Six days of intercalibration tests were conducted between the Oregon and the Pat San Marie during which 30 comparative tows were completed. Tows were made at depths ranging from 100 m to 160 m to detect any differences in relative fishing power between vessels with depth. Tows of one-half and one hour were used to determine if catches from the shorter tows provided the same information as those of longer duration. Data from the comparative fishing will be used to standardize the Oregon catches with the other survey vessels. Comparative fishing to standardize catches of the other vessels was conducted in summer 1975.

RESULTS

I. Data Collection

Table 1 summarizes fishing effort and data collections during the spring survey. In the 191 vessel days in the survey area, 683 tows were made of which 662 were successfully completed. The number of tows per day averaged 3.6 compared to 4.4 per day during the summer 1975 survey. The lower number of stations per day in spring in contrast to summer was due in part to time required to find ice-free stations and to involvement of the Miller Freeman in other than trawling activities during part of her cruise. Although ice cover was quite restrictive in April (covering essentially all of the survey area except for subarea 2), it receded sufficiently during the course of the survey to allow coverage of all of the area planned for the survey. Stations trawled are shown in Figure 1.

Weights and number of fish and invertebrates by species or species groups were determined for each haul. Length measurements were taken from 156,870 fish. Independent otolith or scale samples were taken in each of the four subareas (Figure 1). The total number taken was 6185. Length-weight determinations were made for 2,427 individual fish and length-maturity for 5,530 fish.

II. Preliminary Findings

Frequency of occurrences and CPUE values for major species of fish and crab by region of the survey area are shown in Figure 2. Species composition by subarea was generally similar to that observed in the summer 1975 survey although the rank order was somewhat different. Pollock dominated catches in outer shelf subareas (2 and 3) while yellowfin sole and other flounders were the predominate species in the inner shelf subareas (1 and 4). Yellowfin sole and rock sole were also relatively abundant on the outer shelf compared to that during the 1975 summer survey, demonstrating the migration of these species to deeper waters in winter months.

The abundance of pollock did not appear to be as high relative to other species during the spring 1976 survey as it was during the previous summer's survey. Pollock were spawning in April and May and a greater proportion of the adult population may have been off bottom and beyond the trawl gear in spring and summer.

The abundance of sculpins was surprisingly high, ranking second and third in abundance in the inner shelf subareas (1 and 4) and fifth and sixth in the outer shelf subareas (2 and 3).

The order of abundance of crabs by subarea in spring was similar to that in summer. The Tanner crab (C. opilio) was by far the predominate species in the more northern subareas (3 and 4). In the more southern subareas the Tanner crab (C. bairdi) and the red king crab were both relatively abundant with bairdi crab predominating in the outer shelf subarea 2 and red king crab on the inner shelf subarea 1.

III. Comparison of Survey Results and Objectives

Major objectives of the survey were accomplished. Ice cover proved to be a problem restricting vessel activity in April and May, but all of the planned survey area became ice free prior to the end of the survey period. A number of inshore stations in Bristol Bay were not sampled which probably would have been trawled had it not been for delays caused by the ice earlier in the cruise. An additional number of stations were not trawled on the continental slope because of unfishable bottom.

Haul and catch data were collected for all hauls as planned to provide information on the distribution and relative abundance by area and depth of all species of fish and major species or species groups of invertebrates. The substantial biological data collection will provide descriptions of size

and age composition, growth rates, and length-weight relationships by region of the eastern Bering Sea. These data will also allow estimates of biomass and population size estimates to be made for principal species by age and size group.

VESSEL CAPTAINS AND SCIENTIFIC PARTIES

The successful completion of the survey was due in part to relatively good weather over most of the survey period and a minimum of vessel and equipment breakdowns, but in particular to the outstanding effort of the vessel captains, their crews, and the scientific parties. Those participating in the survey are listed below:

	Anna Marie	Miller Freeman	Oregon	Pat San Marie
Vessel captain:	Bill Jensen	Cdr. Sig Petersen	Wendell Schneider	Bernie Hansen
Party chiefs:	Steve Hughes Jean Dunn Norm Parks	Robert Meyer Ken Waldron	Craig Forrest Richard McIntosh	Fred Wathne Tom Dark Robert Wolotira
Fishery biologists:	Alan Beardsley John Ploeger Janet Wall	Richard Bakkala Doyne Kessler Joo Yeoul Lim(Korean) William Gronlund Don Fisk Craig Forrest Karl Niggol	Duane Rodman Karl Niggol	Larry Bartlett John Ploeger Janet Wall
Fishery Technicians:	Kay Larson Hyla Nelson Scott Ryding Sue Salveson Marty Morin Dave Kingma	Jerry Berger Terry Sample Ron Payne Dick Webber	Jerry Berger Terry Sample Hugh O'Niell Ron Payne Al Spalinger Chuck Cetak	Scott Ryding Marty Morin Chuck Cetak Kay Larson Jan McCrory Dick Webber

Table 1. Summary of fishing activity and data collection by vessel during the multi-vessel trawl survey in the eastern Bering Sea, April-June 1976.

Vessel	Days on Fishing Grounds	Number of Hauls	Biological Data Collected				
			Groundfish				Crabs
			Lengths Measured	Otoliths and Scales Taken	Length-weight Determinations	Length-Maturity Determinations	Carapace Measurements
Anna Marie	42	161	44,020	1,405	365	1,221	21,765
Miller Freeman*	45	117	47,530	2,336	646	1,775	12,810
Oregon**	55	186	26,805	1,000	0	50	25,123
Pat San Marie	49	219	38,515	1,444	1,416	2,484	31,165
Totals	191	683***	156,870	6,185	2,427	5,530	90,863

* Includes 14 days of cruise when main effort was devoted to plankton and benthic invertebrate studies. However, one or two demersal trawl tows per day were completed during this period.

** Data for Oregon includes some that was collected in July and early August during the crab-groundfish survey.

*** 21 of the hauls were not successful due to net damage from hangups or other problems.

Figure 1..Stations sampled during the spring 1976 demersal trawl survey (darkened) and station pattern planned for the 1975 summer survey.

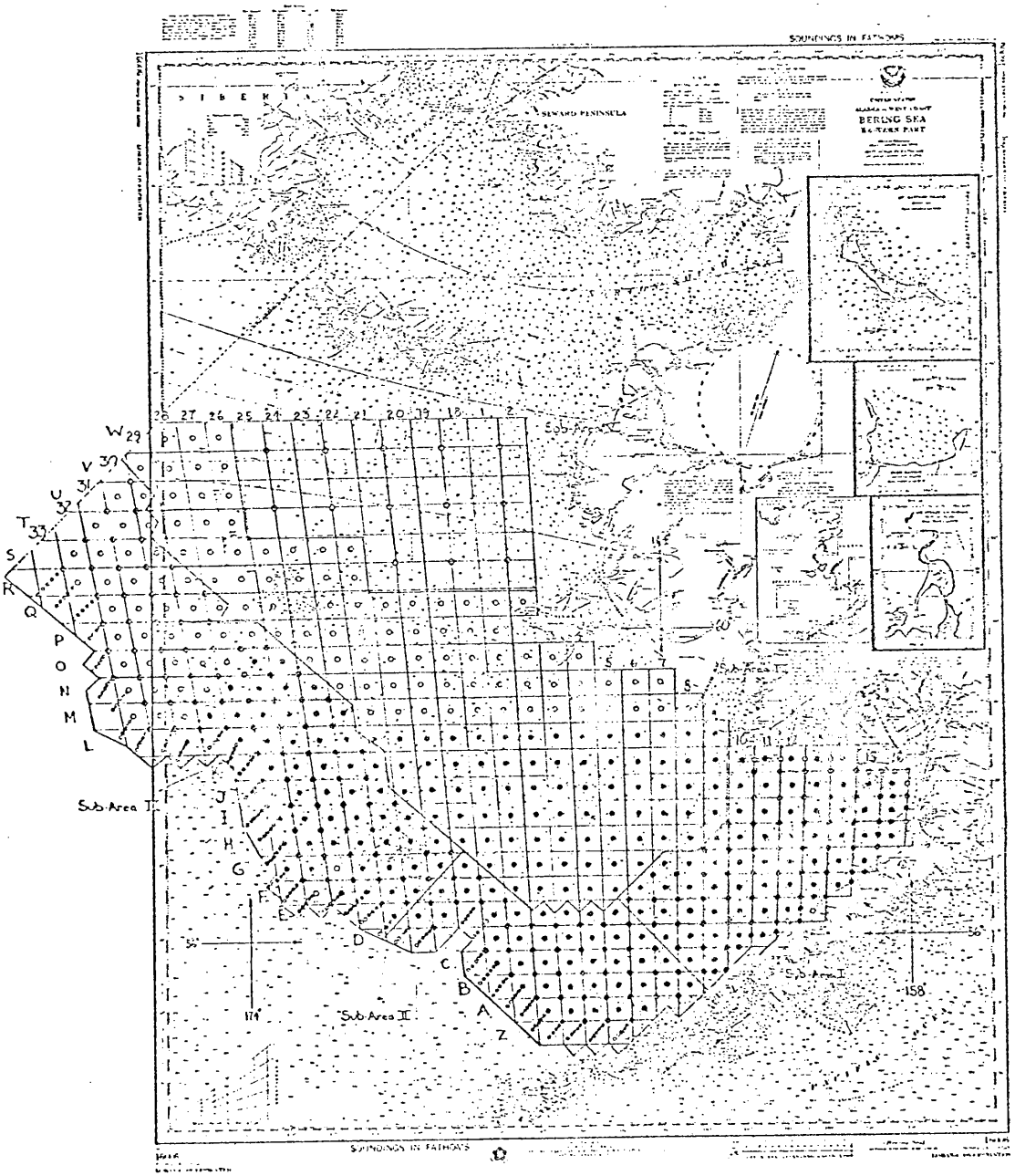
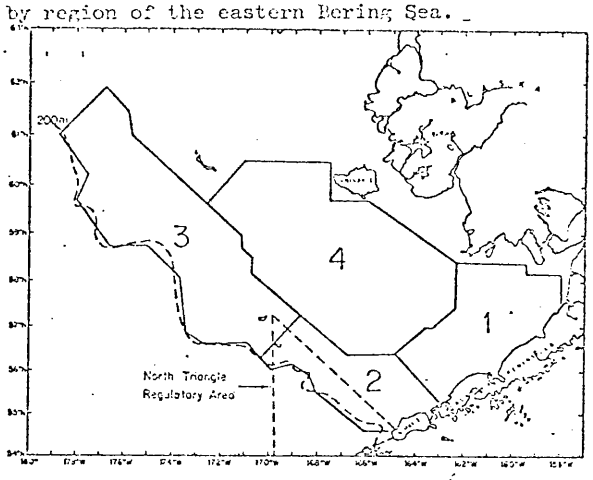


Figure 2. Frequency of occurrence in hauls and rank order by CPUE of ten most abundant species of fish and four most abundant species of commercial crab by region of the eastern Bering Sea.



Subarea 3			Subarea 4		
		GROUNDFISH			
Species	Percent Frequency	CPUE (kg/hr)	Species	Percent Frequency	CPUE (kg/hr)
Pollock	80	130.4	Yellowfin sole	99	179.1
Yellowfin sole	55	94.8	Alaska plaice	99	115.3
Pollock juveniles(<20 cm)	40	52.9	Sculpins	-	92.8
Pacific cod	62	38.1	Rock sole	21	24.5
Sculpins	-	28.2	Poachers	-	14.1
Greenland turbot	85	25.3	Herring	72	7.5
Eelpouts	-	23.0	Longhead dab	53	6.7
Pacific herring	35	19.3	Capelin	82	5.9
Skates	51	15.9	Eelpout	-	2.3
Flathead sole	73	13.4	Pollock	9	1.9
		CRABS			
Tanner crab(C. opilio)	98	127.2	Tanner crab(C. opilio)	85	188.8
Tanner crab(C. bairdi)	81	25.1	Blue king crab	6	3.4
Blue king crab	28	10.8	Tanner crab (hybrid)	38	2.2
Tanner crab (hybrid)	68	8.2	Tanner crab (C. bairdi)	35	1.4

Subarea 2			Subarea 1		
		GROUNDFISH			
Pollock	93	491.7	Yellowfin sole	100	950.3
Yellowfin sole	45	234.1	Sculpins	-	123.0
Rock sole	73	188.3	Rock sole	57	63.8
Pacific cod	84	92.4	Alaska plaice	77	49.2
Flathead sole	82	73.5	Longhead dab	76	23.3
Sculpins	-	72.1	Poachers	-	23.1
Arrowtooth flounder	81	62.8	Pacific herring	36	17.7
Alaska plaice	40	39.9	Pollock	14	10.8
Pacific halibut	69	35.7	Capelin	52	8.3
Eelpouts	-	33.3	Starry flounder	54	6.9
		CRABS			
Tanner crab (C. bairdi)	93	120.7	Red king crab	86	103.3
Red king crab	49	101.5	Tanner crab (C. bairdi)	73	61.7
Tanner crab (C. opilio)	80	94.5	Tanner crab (C. opilio)	50	31.0
Tanner crab (hybrid)	76	13.9	Tanner crab (hybrid)	2	18.8